Electronic Version
Stylesheet Version v1.1.1

Description

Camshaft Adjuster for Vehicles, Especially Motor Vehicles

BACKGROUND OF INVENTION

[0001] 1. Field of the Invention.

[0002] The invention relates to a camshaft adjuster for vehicles, especially motor vehicles, comprising an oscillating motor having a rotor that is fixedly connected to the camshaft and rotatable relative to a stator surrounding the rotor.

[0003] 2. Description of the Related Art.

[0004] Camshaft adjusters are known that have an oscillating motor that is connected at the end of a camshaft by means of a central screw. By hydraulically loading the rotor of the oscillating motor, a rotatory movement relative to the stator results and, in this way, an adjustment of the camshaft relative to the crankshaft is achieved. The supply of hydraulic medium is realized either directly through the camshaft or by means of a rotary lead-through in the os-

cillating motor. It is also known to fasten the rotary lead-through behind the oscillating motor by means of the central screw on the camshaft. The camshaft adjuster has a complex configuration and requires a correspondingly complex assembly.

SUMMARY OF INVENTION

[0005] It is an object of the present invention to configure the camshaft adjuster of the aforementioned kind such that, while providing a simple configuration, an inexpensive assembly is ensured without this negatively affecting the proper function of the camshaft adjuster.

[0006] In accordance with the present invention, this is achieved in that the camshaft comprises at least one connecting part that acts by positive-engagement and/or force transmission and on which the base member of the rotor is fixedly mounted, wherein the base member has a diameter that is different than the diameter of the circle circumscribing the cams of the camshaft.

[0007] In the camshaft adjuster according to the invention, the rotor is fixedly connected by means of a positive-engagement and/or force transmission part to the camshaft. Because of the configuration according to the invention, the camshaft adjuster has only a minimal number of com-

ponents, and this leads to a simple and inexpensive assembly.

[0008] Advantageously, the inner diameter of the base member of the rotor is greater than the diameter of the circle that circumscribes the cams of the camshaft. Accordingly, the oscillating motor can be pushed axially across the cams onto the positive-engagement and/or force transmission part. The camshaft requires therefore only two bearing locations.

Brief Description of Drawings

[0009] Fig. 1 is a perspective illustration, partially in section, of a camshaft adjuster according to the invention.

[0010] Fig. 2 is a perspective illustration of a camshaft of the camshaft adjuster according to Fig. 1 provided with a positive-engagement part for receiving a rotor of the camshaft adjuster.

[0011] Fig. 3 is a second embodiment of a camshaft adjuster according to the invention in an illustration similar to Fig. 1.

[0012] Fig. 4 shows the second embodiment of Fig. 3 in an illustration similar to Fig. 2.

[0013] Fig. 5 shows a third embodiment of the camshaft adjuster according to the invention in an illustration similar to Fig. 1.

[0014] Fig. 6 shows the third embodiment of the camshaft adjuster in an illustration similar to Fig. 2.

[0015] Fig. 7 shows a fourth embodiment of the camshaft adjuster according to the invention in an illustration similar to Fig. 1.

[0016] Fig. 8 shows the fourth embodiment of the camshaft adjuster in an illustration similar to Fig. 2.

[0017] Fig. 9 shows a fifth embodiment of the camshaft adjuster according to the invention in an illustration similar to Fig. 1.

[0018] Fig. 10 shows the fifth embodiment of the camshaft adjuster in an illustration similar to Fig. 2.

[0019] Fig. 11 shows a sixth embodiment of the camshaft adjuster according to the invention in an illustration similar to Fig. 1.

[0020] Fig. 12 shows the sixth embodiment of the camshaft adjuster in an illustration similar to Fig. 2.

[0021] Fig. 13 shows a seventh embodiment of the camshaft adjuster according to the invention in an illustration similar to Fig. 1.

[0022] Fig. 14 shows the seventh embodiment of the camshaft adjuster in an illustration similar to Fig. 2.

[0023] Fig. 15 shows an eighth embodiment of the camshaft ad-

juster according to the invention in an illustration similar to Fig. 1.

[0024] Fig. 16 shows the eighth embodiment of the camshaft adjuster in an illustration similar to Fig. 2.

[0025] Fig. 17 shows a ninth embodiment of the camshaft adjuster according to the invention in an illustration similar to Fig. 1.

[0026] Fig. 18 shows the ninth embodiment of the camshaft adjuster in an illustration similar to Fig. 2.

[0027] Fig. 19 shows a tenth embodiment of the camshaft adjuster according to the invention in an illustration similar to Fig. 1.

[0028] Fig. 20 shows the tenth embodiment of the camshaft adjuster in an illustration similar to Fig. 2.

[0029] Fig. 21 shows in axial section of a camshaft embodied as a hollow shaft with an insert.

DETAILED DESCRIPTION

[0030] The camshaft adjuster according to Figs. 1 and 2 has an oscillating motor 1 comprising a stator 2 and a rotor 3. The stator 2 has a cylindrical outer wall 4 and webs 5 projecting radially inwardly from the wall 4 at a uniform spacing to one another. The rotor 3 is mounted fixedly on the camshaft 6 and has an annular base member 7 that is

fastened fixedly on the camshaft 6. Web-shaped vanes 8 project from the base member 7 radially outwardly and are spaced at a uniform spacing to one another. The end faces 9 of the vanes 8 rest areally on the inner side 10 of the outer wall 4 of the stator 2. The stator webs 5 rest with their end faces 11 areally on the cylindrical outer side 12 of the base member 7 of the rotor 3. The spacing of neighboring stator webs 5 from one another is greater than the width of the rotor vanes 8. The stator webs 5 delimit pressure chambers 13 that are divided by the rotor vanes 8 into two pressure chambers 14 and 15. A pressure medium can be introduced into the pressure chambers 14, 15 in a way known in the art so that the rotor vanes 8 can be pressure-loaded alternatingly on one or the other side. Accordingly, the rotor 3 is rotated relative to the stator 2. The maximum rotational travel of the rotor 3 relative to the stator 2 is achieved when the rotor vanes 8 rest against the stator webs 5.

[0031] On the radial outer ends of the sidewalls 16, 17 of each stator web 5, a recess in the form of a groove 18, 19 is provided that extends across the axial width of the stator webs 5. In the grooves 18, 19, dirt particles, for example, are collected that are contained within the pressure

medium. Moreover, the pressure medium that is contained in the grooves 18, 19 provides a damping action when the rotor vanes 8 come to rest against the sidewalls 16, 17 of the stator webs 5. The stator webs 5 can have very different shapes. For example, the sidewalls 16, 17 of the stator webs 5 can be plane. The sidewalls 16,17 can also have a different course. For example, the cross-sectional width of the stator webs 5 can taper irregularly radially inwardly. The stator 2 itself is provided, as is known in the art, with a chain wheel or pulley 25 across which a chain or belt is guided that is, in turn, guided across a chain wheel or pulley that is mounted on the crankshaft.

[0032] The camshaft 6 has a positive-engagement connecting part 20 that has a non-round cross-section. In the illustrated embodiment of Figs. 1 and 2, the positive-engagement connecting part 20 has a pentagon-shaped cross-section wherein the circumferential surfaces 21 of the positive-engagement connecting part 20 have a rounded transition into one another. The base member 7 of the rotor has an inner wall 22 whose contour is matched to the contour of the positive-engagement connecting part 20. The rotor 3 is pushed onto the positive-

engagement connecting part 20 wherein as a result of the non-round cross-section a proper fixed connection between the rotor 3 and the camshaft 6 is achieved so that the parts cannot rotate relative to one another.

[0033] The cams that are arranged on the camshaft 6 are positioned, as is known in the art, angularly displaced relative to one another. The circumcircle of the cam profiles is smaller than the smallest diameter of the positive-engagement connecting part 20. In this way, it is possible to push the rotor 3 across the cams of the camshaft 6 onto the positive-engagement connecting part 20. In this way, a central drive is enabled in a simple way. By means of the positive-engagement connecting part 20, the supply of the pressure medium that is to be introduced into the pressure chambers 14, 15 of the oscillating motor 1 can be realized. The corresponding bores in the positive-engagement connecting part 20 for supplying the pressure medium are not illustrated in Figs. 1 and 2. In place of such bores, it is also possible to provide annular grooves on the positive-engagement connecting part 20.

[0034] The rotor 3 is fastened with its base member 7 in a suitable way on the positive-engagement connecting part 20, preferably by press-fit. A cylindrical collar 23 adjoins the

positive-engagement connecting part 20. The collar 23 projects radially past the positive-engagement connecting part 20 and serves as an abutment or axial stop for the base member 7 of the rotor 3. By means of this collar 23, the rotor 3 can moved into its mounting position in a simple way during mounting.

[0035] As illustrated in Fig. 1, the base member 7 of the rotor has an axial annular projection 24 with which the base member 7 rest against the collar 23 of the camshaft 6. On this projection 24 a chain wheel 25 is supported that is fixedly connected to the stator 2. The chain wheel or pulley 25 can also be formed as a monolithic part of the stator 2. The chain wheel or pulley 25 closes off the pressure chambers 14, 15 in the axial direction. On the opposite side, a cover plate (not illustrated) is provided that is fastened on the stator 2 and closes off the pressure chambers axially on the other side.

[0036] In the embodiment according to Figs. 3 and 4, the camshaft 6 is extended axially past the positive-engagement connecting part 20. On the projecting cylindrical part 26 of the camshaft 6, an axial securing element 27 is secured by press-fit whose outer diameter is greater than the greatest outer diameter of the positive-en-

gagement part 20. The axial securing element 27 is formed as an annular disk and has on its circumference four grooves 24 that are spaced at an angular spacing of 90E relative to one another and serve as positive-engagement openings for a tool with which the axial securing element 27 can be placed onto the camshaft part 26. As described in the preceding embodiment, the rotor 3 is moved across the cams of the camshaft 6 onto the positive-engagement connecting part 20 and is secured thereon by press-fit. The part 26 projects past the rotor 3 in the axial direction. The axial securing element 27 is fastened on the part 26. For example, it can be pressed onto this projecting part 26. It is also possible to provide the projecting part 26 with a thread so that the axial securing element 27 is screwed onto the part 26. In the mounted position, the axial securing element rests against the cover plate (not illustrated) that is pushed by the axial securing element 27 against the stator 2.

[0037] The oscillating motor 1 is in other respects of the same configuration as in the preceding embodiment.

[0038] In the embodiment according to Figs. 5 and 6, the axial securing element 27 is formed by a spring ring or securing ring that is inserted into an annular groove 29 near

the free end of the projecting part 26 of the camshaft 6.

[0039] In the mounted position, the part 26 of the camshaft 6 projects past the cover plate (not illustrated) of the oscillating motor. Into the annular groove 29 a spring ring or securing ring 27 is inserted so that the oscillating motor 1 is properly axially secured on the positive-engagement connecting part 20 of the camshaft 6.

[0040] In the oscillating motor according to Figs. 7 and 8, a spring ring or securing ring is used as the axial securing element 27 that is provided in the annular groove 29 near the free end of the axially projecting end of the camshaft 6.

[0041] The positive-engagement connecting part 20, in contrast to the preceding embodiment, is substantially cylindrical. The positive-engagement connecting part 20 has on its outer wall 30 at least one positive-engagement element 31 that is formed as a projection on the outer wall 30. This positive-engagement element 31 has a substantially rectangular contour and extends from the collar 23 in the direction toward the annular groove 29. As illustrated in Fig. 8, the axially extending positive-engagement element 31 has a sufficient spacing from the annular groove 29 so that, when mounting the oscillating motor 1, the spring

ring or securing ring 27 can be inserted simply into the annular groove 29.

[0042] The inner wall 22 of the base member 7 of the rotor 3 has for receiving the positive locking element 31 a matching groove-shaped depression 32 that is engaged positively by the positive-engagement element 31. By means of this positive-engagement connection 31, 32, the rotor 3 is connected fixedly to the camshaft 6. Since the rotor 3 is not secured by press-fit on the positive-engagement connecting part 20, a problem-free mounting of the rotor 3 is ensured. It can be easily pushed onto the positive-engagement connecting part 20. The axial securing action is realized by the spring ring or securing ring 27 that can be inserted without problems into the annular groove 29 of the camshaft part 26.

[0043] On the outer wall 30 of the positive-engagement connecting part 20 additional positive-engagement elements 31 can be provided should this be necessary.

[0044] Figs. 9 and 10 show an oscillating motor where the annular projection 24 of the base member 7 of the rotor has an inner wall 33 with a non-round cross-section. The rotor is seated with this projection 24 on the positive-engagement element 20 of the camshaft 6. In contrast to the

preceding embodiments, the positive-engagement connecting part 20 is formed as a collar that has only minimal axial width. The positive-engagement connecting part 20 has the same contour as the positive-engagement connecting part 20 of the preceding embodiment. The positive-engagement connecting part 20 adjoins directly the collar 23 that projects radially past the positive-engagement connecting part 20. The part 26 that is positioned on the other end of the positive-engagement connecting part 20 is cylindrical and has at its free end an annular groove 29 that receives the spring ring or securing ring 27 as an axial securing element.

[0045] In this configuration, the rotor 3 can also be pushed across the cams of the camshaft 6 to such an extent that it engages with its projection 24 the positive-engagement connecting part 20. In this way, the rotor 3 is connected in a simple way fixedly to the camshaft 6. The camshaft projects with its part 26 so far axially past the rotor 3 or the cover plate (not illustrated) that the spring ring or safety ring 27 can be inserted into the annular groove 29.

[0046] The rotor 3 is then properly secured axially on the camshaft 6. In other respects, the oscillating motor 1 is of the same configuration as in the preceding embodiments.

[0047] Figs. 11 and 12 show an oscillating motor 1 whose rotor 3 is pushed onto the positive-engagement connecting part 20 of the camshaft 6. The positive-engagement connecting part 20 is identical to the embodiment of Figs. 1 and 2. As a result of the non-round cross-section of this positive-engagement connecting part 20, the rotor 3 is fixedly fastened on the camshaft 6. For axially securing the rotor 3 or the oscillating motor 1 on the camshaft 6, the axial securing element 27 as well as a groove nut 24 are provided. The axial securing element 27 in this embodiment is a securing disk that rests against the end face of the cover plate (not illustrated) and is secured by means of the groove nut 34. It is screwed onto a tapered threaded end of the camshaft 6. The rotor 3 is positioned axially secured between the collar 23 and the annular disk 27.

[0048] In other respects, the camshaft adjuster is of the same configuration as in the embodiment of Figs. 1 and 2.

[0049] The camshaft adjuster according to Figs. 13 and 14 comprises the positive-engagement connecting part 20 with the positive-engagement element 31 in accordance with the embodiment of Figs. 7 and 8. The camshaft 6 is provided in accordance with the preceding embodiment with a threaded end onto which the groove nut 34 is screwed.

By means of the nut, the axial securing element 27 in the form of the annular disk is secured; the annular disk rests against the cover plate (not illustrated) or the rotor 3 of the oscillating motor 1 and axially secures it between the collar 23 and the axial securing element 27 in the mounted position. In other respects, the oscillating motor is identical to the embodiment of Figs. 11 and 12.

[0050] The camshaft adjuster according to Figs. 15 and 16 is similarly configured as the embodiment of Figs. 3 and 4. In accordance with this embodiment, the axial securing element 27 is positioned on the projecting part 26 of the camshaft adjuster 6. Instead of the positive-engagement connecting part 20, the camshaft 6 has a cylindrical part 35 on which the rotor 3 is secured with press-fit. The fixed connection between the rotor 3 and the camshaft 6 is realized in this case by force transmission (friction). Onto the free end of the part 26 of the camshaft 6, the axial securing element 27 is placed in the same way as described in connection with Figs. 3 and 4. The rotor 3 is thus axially secured between the collar 23 of the camshaft 6 and the axial securing element 27 on the camshaft 6.

[0051] In the embodiment according to Figs. 17 and 18, the camshaft 6 has the positive-engagement connecting part

20 with positive-engagement element 31 in accordance with the embodiment of Figs. 7 and 8. The part 26 that projects axially past the positive-engagement connecting part 20, in contrast to the embodiment of Fig. 7 and 8, is not provided with an annular groove 29 but has a continuous cylindrical configuration. On this projecting part 26, the axial securing element 27 is fastened that is identical to that of the embodiment of Figs. 3 and 4. The axial securing element 27 in the embodiment of Figs. 17 and 18 can be attached in the same way as explained in connection with the embodiment of Figs. 3 and 4. The rotor 3 of the oscillating motor 1 is axially secured between the collar 23 of the camshaft 6 and the axial securing element 27.

[0052] In the embodiment of Figs. 19 and 20, the camshaft 6 is provided with an axially projecting force transmission part 36 projecting past the collar 23 and configured to be of a truncated-cone shape. The base member 7 of the rotor 3 of the oscillating motor 1 is fastened on the part 36 by means of press-fit. The inner wall 22 of the rotor base member 7 is positioned on a conical surface.

[0053] Because of the force transmission between the rotor base member 7 and the force transmission part 36 of the

camshaft 6, a proper fixed connection between the rotor 3 and the camshaft 6 is achieved. It is possible without problems to axially secure the rotor 3 by means of an axial securing element on the camshaft 6. The provided axial securing element 27 can be configured in accordance with the preceding embodiments.

[0054] In the described embodiments, the camshaft 6 requires only two bearing locations. In particular, only a minimal number of components is required because a rotary lead-through for the pressure medium in the oscillating motor 1 is obsolete. The central screw required in the known camshaft adjusters for attachment of the oscillating motor to the camshaft is also no longer needed. The camshaft adjuster according to the described embodiments can therefore be produced simply and inexpensively. The supply of pressure medium into the pressure chambers 14, 15 is realized through the camshaft 6. In this way, radial bores for supply of pressure medium are not necessary. However, when the camshaft 6 is of a hollow configuration, an insert 37 with oil channels must be inserted as illustrated in Fig. 21. The insert 37 rests against the inner wall 38 of the hollow camshaft 6 and has two axially extending bores 39 and 40 through which the pressure

medium can be introduced into the pressure chambers 14, 15 of the oscillating motor 1. The two bores 39, 40 open into a first end face 41 of the insert 37 and are connected, as is known in the art, to the valve unit with which the supply of pressure medium to the pressure chambers 14, 15 is controlled.

[0055] Radial bores 42, 43 that are spaced from one another open into the bore 39; they are provided at the bottom of an annular groove 44, 45 in the wall surface 46 of the insert 37, respectively.

[0056] The radial bores 47, 48 open in the annular groove 44, 45 into the camshaft 6.

[0057] Radial bores 49, 50 that are spaced from one another open into the axial bore 40 of the insert 37; they are provided at the bottom of two annular grooves 51, 52 in the wall surface 46 of the insert 37, respectively. Radial bores 53, 54 of the camshaft 6 open into the annular groove 51, 52.

[0058] When employing a hollow camshaft 6 with the insert 37, the constructive length can be reduced.

[0059] The axial securing of the oscillating motor 1 is realized in the described embodiments by means of the axial securing element 27 or by means of a press-fit connection.

[0060] In the embodiments in which the positive-engagement connecting part 20 has a polygonal or non-round cross-section (Figs. 1 through 6, 9 through 12), it is advantageous when the number of corners corresponds to the number of rotor vanes 8. In this way, a uniform stress distribution is ensured in the rotor 3.

[0061] While specific embodiments of the invention have been shown and described in detail to illustrate the inventive principles, it will be understood that the invention may be embodied otherwise without departing from such principles.